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Differences in Complication Rates of Gluteoplasty Procedures That Utilize Autologous Fat Grafting, Implants, or Local Flaps

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Background: Gluteoplasty (gluteal augmentation) procedures are increasing in popularity, but there is not a universally accepted technique to produce optimal outcomes while minimizing risk. In this systematic review, we perform a meta-analysis to evaluate rates of complication from autologous fat grafting, implants, and local flaps, which are the three most common gluteoplasty operations.

Methods: A search of the PubMed/MEDLINE database for articles including the terms "gluteoplasty" OR "gluteal augmentation" OR "buttock augmentation" OR "Brazilian butt lift" OR "gluteal autologous fat graft" OR "buttock autologous fat graft" OR "gluteal implant" OR "buttock implant" OR "gluteal flap" OR "buttock flap" generated 229 articles. This number was brought down to 134 after initial screening by title. Inclusion criteria then removed those not written in English, those without access to the full text, those without extractable data on complications, and duplicates, leaving 46 articles to examine.

Results: A total of 4362 patients who underwent gluteoplasty between 1992 and 2017 were found. The overall complication rate was 12.4%. Implants had the highest rate (31.4%), whereas fat grafting had the lowest (6.8%); flaps were intermediate (23.1%). A χ^2 test yielded a statistically significant ($P < 0.001$) nonindependent relationship between combined complication rate and type of surgery. Individual complications, such as asymmetry, capsular contracture, fat embolism, hematoma, infection, necrosis, pain, seroma, wide scar formation, and wound dehiscence, were also analyzed.

Conclusions: Fat grafting by plastic surgeons might be the best option for gluteoplasty with regard to complications. In certain cases, however, there may only exist one choice for an operation because of anatomical limitations, which predisposes patients to those associated complications.

Key Words: gluteoplasty, fat grafting, implants, flaps

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Bartels et al[1] first described gluteoplasty in 1969, correcting a gluteal asymmetry using a breast prothesis.[2] Sometimes referred to as a *Brazilian butt lift*, these procedures have grown in frequency in the United States owing to the prominence of changing beauty standards of the buttocks in celebrity media. According to the American Society of Plastic Surgeons, 21,624 gluteoplasties were performed in 2017, an increase of more than 125% from 2012.[3] Furthermore, buttock augmentation with fat grafting in 2017 accounted for the third highest increase of any cosmetic surgery from the previous year.[3]

Determinants of female physical attractiveness comprise a widely studied endeavor, with factors such as body mass index and curvaceousness, or the degree of "hourglass," at the forefront.[4] Another element has persisted too, the waist-to-hip ratio, which helps to define not only attractiveness but health and reproductive potential as well.[5] The ideal value of the ratio has been a constant 0.7 across cultures, and only minor differences in fullness exist.[6] However, as the atmosphere of what people consider beautiful has transformed, 0.60 and 0.65 are emerging as the best suitors, indicating a preference for a smaller waist and bigger buttocks.[7]

Since operations involving the buttocks have seen a sharp uptick in demand over the past half decade, it is only salient that plastic surgeons question whether operative results in terms of complications are better achieved with the original implant technique or the newer fat grafting technique. In some cases, especially those that deal with correcting prior surgeries, local flaps become another possibility. We sought to examine the literature to understand how to optimize postoperative outcomes by diminishing complications for patients requesting gluteoplasty and present within this systematic review a meta-analysis that identifies which of the three aforementioned techniques may be used. Of note is exclusion of the technique that uses hyaluronic acid gel injections because of temporary satisfaction and lack of long-term follow-up with this method.

METHODS

We searched the PubMed/MEDLINE database for articles containing the terms "gluteoplasty" OR "gluteal augmentation" OR "buttock augmentation" OR "Brazilian butt lift" OR "gluteal autologous fat graft" OR "buttock autologous fat graft" OR "gluteal implant" OR "buttock implant" OR "gluteal flap" OR "buttock flap." After title screening and application of inclusion criteria, we eliminated unwarranted articles, specifically those not written in English, those without access to the full text, those without extractable data on complications, and duplicates. Data on surgical technique (autologous fat grafting, implants, local flaps), number of patients, total number of complications, and specific complications were subsequently collected. In all instances, articles were closely scrutinized to ensure that overlapping-specific complications were not counted more than once in the total count.

A χ^2 test of independence was conducted to determine if there is a relationship between type of surgery and total complications. A P value less than 0.05 was considered significant. Further post hoc testing with 2×2 contingency tables and the χ^2 test of independence were carried out to ascertain a hierarchy of surgery type with regard to complication rate. This was accomplished with implementation of the Bonferroni-adjusted α of 0.0167 to reconcile the 3 pairwise comparisons. Lastly, each of the following specific complications, noted to be the 10 most documented, was looked at: asymmetry, capsular contracture, fat embolism, hematoma, infection, necrosis, pain, seroma, wide scar formation, and wound dehiscence. In particular, all surgery types had these complications accounted for. Statistical analyses were performed with JASP version 0.8.1.1 (Amsterdam, the Netherlands).

RESULTS

The initial database search returned 229 results, which was cut down to 134 after screening by title and 46 after inclusion criteria were applied.

Between 1992 and 2017, the 46 studies reported on 4362 patients and resulted in 553 complications (Table 1), for an overall rate of 12.4% (Table 2). Breaking it down by technique, fat grafting had 219

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TABLE 1. Number of Patients and Total Complications by Article

Primary Author	Year	Technique	No. Patients	No. Total Complications
Abboud	2015	Graft	110	9
Aboudib	2012	Implant	103	11
Alperovich	2007	Implant	1	1
Andrade	2017	Implant	12	2
Astarita	2015	Graft	1	1
Badin	2007	Implant	28	9
Cardenas Restrepo	2002	Graft	96	14
Cárdenas-Camarena	2011	Graft	789	38
Chang	2008	Flap	1	1
Colwell	2007	Flap	18	6
de la Peña-Salcedo	2013	Implant	114	89
de Pedroza	2000	Graft	879	14
de Runz	2015	Flap	55	22
Favinger	2017	Implant	1	1
Flores-Lima	2008	Implant	1	1
Ford	1992	Implant	1	1
Gonzalez	2006	Implant	1	1
Hultman	2006	Flap	25	16
Le-Quang	1980	Flap	2	1
Mejia	2012	Flap	5	1
Muresan	2014	Graft	9	1
Murillo	2004	Graft	162	81
Nicareta	2011	Graft	351	13
Park	2016	Implant	130	33
Pereira	2008	Graft	2	0
Raposo do Amaral	2006	Graft	2	0
Raposo do Amaral	2006	Flap	9	3
Roberts	2011	Graft	566	16
Rohde	2005	Graft	62	21
Rosique	2015	Graft	106	6
Salamat	2015	Implant	3	0
Salgado	2014	Graft	8	0
Senderoff	2011	Implant	200	78
Senderoff	2017	Implant	19	5
Serra	2012	Implant	40	8
Sozer	2012	Flap	200	20
Sozer	2005	Flap	20	7
Swanson	2016	Graft	25	0
Talbot	2010	Graft	1	1
Tavares Filho	2011	Implant	2	0
Thomas	2012	Flap	1	0
Tremp	2016	Graft	3	1
		Flap	1	1
Vergara	1996	Implant	160	16
Vongpaisarnsin	2015	Graft	1	1
Wang	2013	Graft	12	2
Willemsen	2013	Graft	24	0
Total			4362	553

complications in 3209 patients, implants 256 in 816, and flaps 78 in 337. As such, fat grafting had the lowest complication rate at 6.8% and implants had the highest at 31.4%; flaps were intermediate at 23.1%. The χ^2 test of independence yielded a significant P value of less than 0.001, indicating an association between technique and complications (Table 2).

Pairwise comparisons between the 3 groups were also significant, this time at the Bonferroni-adjusted α. χ^2 Analysis yielded P values of less than 0.001 for fat grafting versus implants, less than 0.001 for fat grafting versus flaps, and 0.005 for implants versus flaps, confirming a hierarchy of best technique to reduce complications of fat grafting, then flaps, then implants.

In terms of asymmetry, implants had the greatest complication rate of 2.45% (20 complications among 816 patients); fat grafting, the least at 0.12% (4/3209); and flaps, the middle at 0.89% (3/337). Implant gluteoplasty was the only technique that saw capsular contracture, at 1.10% (9 patients). Fat grafting was the only technique that saw fat embolism, at 0.09% (3 patients). As for hematoma, implants once again had the greatest rate of 1.47% (12 patients); fat grafting, the least at 0.03% (1); and flaps, the middle at 0.89% (3). This order held true for infection as well, with implants having a rate of 4.53% (37 patients); flaps, 2.37% (8); and fat grafting, 0.78% (25). For necrosis, implant gluteoplasty was the sole technique that had no complications, whereas flap gluteoplasty had a rate of 8.01% (27 patients) and fat grafting had a rate of 0.56% (18). The single instance in which fat grafting had the greatest rate was with pain, at 2.06% (66 patients); flaps were next at 0.59% (2) and implants last at 0.12% (1). Seroma had the greatest individual rate of all complications, in implants at 13.60% (111 patients), which was followed by flaps at 3.56% (12) and fat grafting at 2.37% (76). For wide scar formation, zero complications were seen for flaps, as opposed to a rate of 1.23% (10 patients) for implants and 0.28% (9) for fat grafting. Finally, wound dehiscence was present with all techniques, 6.25% (51 patients) for implants, 5.04% (17) for flaps, and 0.16% (5) for fat grafting (Fig. 1).

Interestingly, there was just one death among all 4362 patients, which occurred with one of the emboli from fat grafting.

DISCUSSION

With an overall complication rate of 12.4%, gluteoplasty as a whole seems like a relatively safe procedure. We have shown that fat grafting is the best option when it comes to preventing postoperative complications, in which there is a low 6.8% rate of complication. Moreover, we have targeted implants as being the least safe of the gluteoplasty techniques, as its complication rate was found to be 31.4%. Flaps had a rate between the two but closer to implants, at 23.1%.

When it came to the 10 most documented complications, implants was at the top in asymmetry, capsular contracture, hematoma, infection, seroma, wide scar formation, and wound dehiscence. Fat grafting was first in both fat embolism and pain. Flaps were only first in necrosis. Death, which was not individually recognized as its own complication category, was reported in just 1 of the 3 emboli cases. This may be attributed to underreporting by surgeons because of a variety of reasons. Gluteal fat grafting has been well documented to be implicated in fatal cases performed by physicians both outside and within the United States because of subsequent pulmonary emboli.[8,9] In fact, an urgent advisory was recently sent to all plastic surgeons in response to the unusually high mortality rate, estimated to be as high as 1:3000.[10] With an expectation of touch-ups after fat grafting, this was never

TABLE 2. Overall Complication Rates

Technique	No Complication	Complication	Rate, %
Graft	2990	219	6.8
Implant	560	256	31.4
Flap	259	78	23.1
Total	3809	553	12.4

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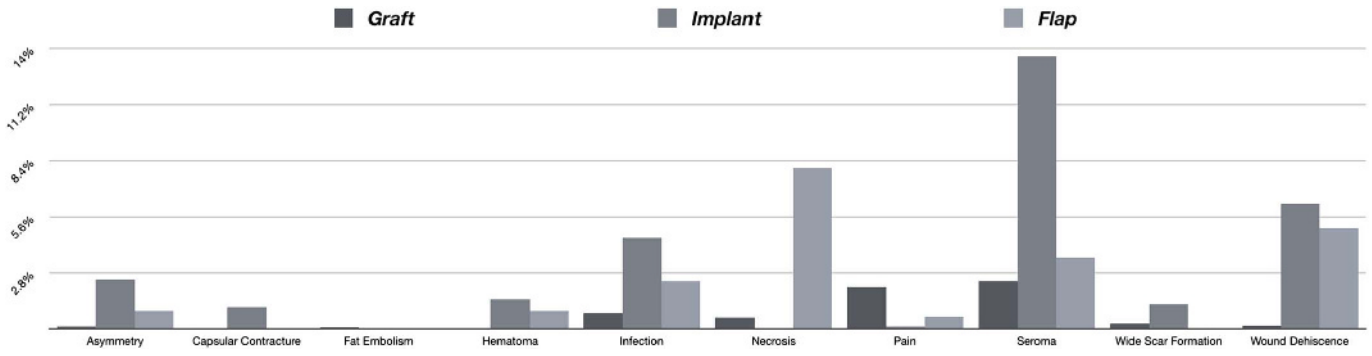

FIGURE 1. Ten most documented complications broken down by technique.

considered a complication. A future direction will identify the rate of secondary surgeries.

The most notable limitation of our analysis is that approximately half of the patient sample comes from four studies (Cárdenas-Camarena 2011, de Pedroza 2000, Nicareta 2011, Roberts 2011), which may point to a selection bias in that more experienced surgeons are more likely to publish their findings and that they have much lower complication rates. Moreover, some case reports were incorporated, but they did not drastically alter the findings. Another limitation can be found in the study design—variations in reporting style—such as minor pain left out of some studies and authors having a high threshold for what qualifies as wide scar formation.

With a significantly lower rate of complication, is fat grating ideal for gluteoplasty? If one combines this evidence with the benefits of lack of immunogenicity, simple surgical procedure, easy accessibility, no device implantation, and low cost, it is the favorite, albeit not substantiated with a prospective, randomized study.[11] Death and high-fat resorption are clearly concerning, though.[12] The Multi-Society Gluteal Fat Grafting Task Force notes the danger, concluding that "fat should never be placed in the muscle [but rather] only […] in the subcutaneous tissue."[10] Nevertheless, skilled surgeons with proper understanding of gluteal anatomy should continue to make use of fat grafting for aesthetic and reconstructive purposes because of the stated low complication rate. We expect subcutaneous fat transfer to remain the frontrunner for a foreseeable time among the choices currently available for gluteoplasty.

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